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HAZARDOUS MATERIALS: TRANSPORTATION OF OXIDIZING GASES ON AIRCRAFT

Notice of Proposed Rulemaking
(14 CFR Parts 172, 175 and 178)

Jeffrey Goode, Ph.D.

Office of Aviation Policy and Plans
Operations Regulatory Analysis Branch, APO-310
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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The U.S. Research and Special Programs Administration (RSPA) would amend with this Notice of Proposed Rulemaking (NPRM) the Hazardous Materials Regulation. This NPRM would require that a cylinder containing compressed oxygen or chemical oxygen generator be placed in a protective outer container that meets certain flame penetration and thermal resistance requirements when transported aboard an aircraft in other than the passenger cabin. RSPA would also prohibit the transportation of all other oxidizing gases aboard cargo and passenger aircraft.

The purpose of this rulemaking is to reduce the risk of a catastrophic fire due to the release of oxygen from an oxygen cylinder or from an oxygen generator during an on-board fire in one of the cargo compartments. The consequences of an oxygen fueled fire could be catastrophic. RSPA has determined that this proposed rule would generate benefits for system users by reducing the risk of a catastrophic fire.

The total cost of the rule over 15 years is $145.4 million ($92.3 million discounted). Oxygen cylinder overpacks account for $32.2 million ($21.2 million discounted) and oxygen generator overpacks account for $113.2 million ($71.1 million discounted). Average annual cost is $9.7 million per year.

The proposed rule is not expected to have a significant impact on a substantial number of small entities nor is it expected to have a significant impact on international trade. The proposed rule does not contain any Federal intergovernmental or private sector mandate.

I. INTRODUCTION AND BACKGROUND

RSPA proposes to amend the Hazardous Materials Regulations to require that cylinders of compressed oxygen and chemical oxygen generators be placed in a protective outer container that meets certain flame penetration and thermal resistance requirements when transported aboard an aircraft in other than the passenger cabin. RSPA is also proposing to revise the pressure relief device setting limit on cylinders of compressed oxygen, to limit the types of cylinders authorized to transport compressed oxygen aboard aircraft and to prohibit the transportation of all other oxidizing gases aboard cargo and passenger aircraft. RSPA and the Federal Aviation Administration (FAA) developed this proposal jointly.

On May 11, 1996, ValuJet flight 592 crashed into an Everglades swamp shortly after takeoff from Miami International Airport, Florida. The two pilots, three flight attendants, and all 105 passengers were killed. Before the accident, the flight crew reported to air traffic control that it was experiencing smoke in the cabin and cockpit. The evidence indicates that five boxes containing as many as 144 chemical oxygen generators, most with unexpended oxidizer cores, along with three aircraft wheel/tire assemblies had been loaded in the forward cargo compartment shortly before departure. These items were being shipped as company material.

On August 19, 1997, the NTSB issued its aircraft accident report entitled "In-Flight Fire and Impact with Terrain; ValuJet Airlines Flight 592." In that report, the NTSB determined that one of the probable causes of the accident was a fire in the airplane's Class D cargo compartment that was initiated by the actuation of one or more of the chemical oxygen generators being improperly carried as cargo.

On August 19, 1999, the Research and Special Programs Administration (RSPA) published a final rule under Docket No. HM-224A (64 FR 45388) that imposed more stringent requirements on the transportation of cylinders of compressed oxygen by aircraft. These new requirements were designed to reduce the possibility that, in the event of a fire occurring in a cargo compartment containing cylinders of compressed oxygen, the oxygen might be released and intensify the fire which might overcome the various cargo compartment devices designed to suppress or contain fires in the compartment.

As noted in the final rule in HM-224A the Federal Aviation Administration (FAA) conducted tests demonstrating that a fire in a cargo compartment can generate sufficient heat to cause an unprotected oxygen cylinder to release its contents which would intensify the fire to such an extent that the fire could overcome the compartment's halon fire suppression system and cause severe damage to the aircraft. The FAA also found that oxygen cylinders release their contents at temperatures well below those temperatures that the aircraft cargo compartment liners and structures can withstand. However, FAA testing demonstrated that placing the oxygen cylinder in a protective outer container lengthens the time before a cylinder releases its contents. Based on these findings, HM-224A limited the number of oxygen cylinders (including passenger's medical oxygen) that may be carried as cargo in certain types of aircraft cargo compartments, required each oxygen cylinder to be placed in an ATA specification 300 Category I shipping container developed by the Air Transport Association (ATA) for shipping containers transported on board aircraft, and required that each cylinder of compressed oxygen be stowed horizontally on the compartment floor or as close as practicable to the floor.

The ATA Specification 300 Category I shipping container is a resilient, durable container that provides protection from shock and vibration. As noted in HM-224A, this shipping container provides an increased level of protection for oxygen cylinders. The effective date of the requirement adopted in HM-224A was March 1, 2000; voluntary compliance was authorized beginning October 22, 1999.

The FAA testing, discussed above, indicated that even more protection than that provided by the ATA specified shipping container was needed to improve the safety of carrying compressed oxygen. This additional protection could be provided by an improved overpack that provides thermal protection and satisfies a flame penetration criterion. In HM-224A RSPA announced that it was considering amending the Hazardous Material Regulations (HMR; 49 CFR Parts 171-180) to require the improved outer container for oxygen cylinders and it anticipated publishing a notice of proposed rulemaking. This proposed rule would require that a cylinder of compressed oxygen be placed in a flame-resistant and thermal-resistant outer container when transported in any cargo compartment of a passenger-carrying or cargo aircraft. Because of the added safety margin associated with these improved outer containers, this proposed rule would also remove the limits imposed in § 175.85 (i) on the number of oxygen cylinders that may be transported in cargo compartments.

During development of this NPRM, RSPA and FAA also reviewed the possible effects that heat from a cargo compartment fire would have on a package of properly prepared and transported chemical oxygen generators. The FAA determined that if exposed to the heat and/or flame associated with a cargo compartment fire, a properly prepared and transported oxygen chemical generator could release oxygen and intensify the fire to the extent that the fire would overcome the compartment's halon fire suppression system and cause severe damage to the aircraft. Therefore, this rulemaking proposes to require that chemical oxygen generators, when transported aboard cargo-only aircraft, be placed in a protective outer container that meets the same flame penetration and thermal resistance requirements as for the compressed oxygen cylinders.

Finally, this proposed rule would prohibit the transportation of all other oxidizing gases aboard cargo and passenger aircraft. These affected materials are covered under the shipping descriptions "Air, refrigerated liquid, (cryogenic liquid)", "Carbon dioxide and oxygen mixtures, compressed", "Nitrous oxide", "Nitrogen triflouride, compressed", "Compressed gas, oxidizing", and "Liquefied gas, oxidizing."

The proposed regulations would require that an outer container for an oxygen cylinder or a chemical oxygen generator meet the standards in Part III of Appendix F to 14 CFR Part 25, Test Method to determine Flame Penetration Resistance of Cargo Compartment Liners. In order to comply with the requirements of the flame penetration resistance test, a flat 16 by 24-inch test specimen must be constructed that represents the outer package design. At least three specimens of outer packaging materials and each design feature must be tested. Each specimen must simulate the oxygen cylinder outer packaging, including any design features, such as handles, latches, seams, hinges, etc., the failure of which would affect the capability of the outer packaging to prevent actuation of the oxygen cylinder pressure relief mechanisms or actuation of a chemical oxygen generator. Each specimen must be placed in the horizontal ceiling position of the test apparatus, and must prevent flame penetration for at least a period of 5 minutes. The maximum allowable temperature at a point 4 inches above the test specimen, centered over the burner cone may not exceed 400°F. Typically, the overpack closure mechanism, seam or hinges are tested independently in a longitudinal fashion, centered over the burner flame. See "Burnthrough Test Procedures for Cargo Liner Design Features", DOT/FAA/CT-TN 88/33.

In addition, this proposed rule would require that a cylinder of compressed oxygen or chemical oxygen generator cylinder remain below the temperature at which its pressure relief mechanism would activate when the container holding the cylinder is exposed to a mean temperature of

400°F for three hours. The 400°F temperature is the estimated mean temperature of a cargo compartment during a halon-suppressed fire[1]. Three hours and 27 minutes is the maximum estimated diversion time for an aircraft flying a southern or mid-Pacific oceanic route. Data collected during the FAA tests indicates that, on average, an oxygen cylinder's pressure relief mechanism will open when surface temperature of the cylinder reaches approximately 300°F. In order to ensure an adequate safety margin, the RSPA is proposing that a cylinder or chemical oxygen generator not reach an external temperature of 199°F when the container which holds that cylinder is exposed to a 400°F temperature for three hours.

Additionally the regulation would revise the limit on pressure relief device (PRD) settings on cylinders containing compressed oxygen. This will ensure that the cylinder does not burst at temperatures that the cylinder might experience if exposed to heat while protected by the outer packaging. Specifically RSPA proposes that oxygen cylinders be equipped with PRD's that have a set pressure equal to cylinder test pressure with tolerance of -10% to 0%. For oxygen transported in DOT 3HT specification cylinders, RSPA proposes that the PRD have a rated burst pressure of 90% of the cylinder test pressure with a tolerance of –10% to +0%. Additionally, RSPA proposes that the cylinders authorized for transport of compressed oxygen aboard aircraft be limited to DOT specifications 3A, 3AA, 3 AL and 3HT. These are the most common cylinders in oxygen service.

During the development of this NPRM, RSPA began to look at the total system of the cylinder within the improved overpack. RSPA became aware of the need for limitations on the pressure relief device settings (PRD) for the cylinders used to transport oxygen by aircraft. If cylinders

[1] The FAA is currently evaluating other non-ozone depleting suppression agents that could eventually be used in cargo compartments. Some of the agents can maintain an adequate level of safety in the compartment, but the mean temperature may be slightly higher than 400°F, which is the level found during typical halon-suppressed fires. If an alternate agent is used, the oven temperature level may need to be adjusted accordingly.

do not have the proper PRD settings, then improved overpack will not have the desired result of keeping the gas in the cylinder in the event of a fire situation. RSPA believes that industry is for the most part already using PRD's within the settings that we are proposing, in this NPRM.

II. RISKS AND BENEFITS

The purpose of this rulemaking is to reduce the risk of an airplane cargo compartment fire becoming a catastrophic fire due to the release of oxygen from a cylinder containing compressed oxygen or from a chemical oxygen generator. While the risk of this type of catastrophic fire is small, that risk cannot be ignored because materials like chemical oxygen generators and cylinders containing compressed oxygen are carried in the cargo compartments of airplanes. The RSPA has determined that this proposed rule would generate benefits for system users by reducing that risk.

RSPA has reviewed the National Transportation Safety Board's (NTSB) database of historical aviation accidents and incidents and the FAA Accident/Incident Database (AIDS) data base to find accidents or incidents due to fire in the cargo compartment. Three accidents and 10 incidents involving airplane cargo compartment fires have occurred between 1986 to 2002, as shown in Table 1. This data shows that these types of fires occur about once a year.

Table 1. Accidents and incidents due to fire in the cargo compartment

Date	City & State	Event Type	Injuries: Fatal	Serious	Minor	None	Aircraft Damage
3/7/2002	Lincoln, NE	Incident				45	Minor
2/10/2001	Columbus, OH	Incident					Minor
11/8/1998	Atlanta, GA	Incident				4	Minor
7/7/1998	Rapid City, SD	Incident				2	Minor
9/5/1996	Newburgh, NY	Accident			2		Destroyed
5/11/1996	Miami, FL	Accident	110				Destroyed
8/11/1995	Nikolai, AK	Accident				1	Substantial
12/11/1992	Adak, Ak	Incident				66	Minor
2/1/1991	Greensboro, NC	Incident				37	Minor
1/10/1990	Detroit, MI	Incident				2	Minor
2/3/1988	Nashville, TN	Incident			18	113	Minor
11/25/1986	Ontario, CA	Incident				124	Minor
8/10/1986	Chicago, IL	Incident				7	Destroyed

A fire in a cargo compartment could cause the release of oxygen from an oxygen generator or from a cylinder of compressed oxygen, if either is in that cargo compartment, which in turn could cause a catastrophic fire onboard the aircraft. The cost of a catastrophic accident can be estimated in terms of lives lost and property damage. A Boeing 737 represents a typical airplane flown domestically. The fair market value of a Boeing 737 is about $20 million, and it has 113 seats. The average passenger load factor is 65%, which translates into 73 passengers per flight (a Boeing 737 will also have 2 pilots and 3 flight attendants). If a cargo compartment fire in a Boeing 737 becomes a catastrophic fire, the casualty cost is estimated to be $234 million (78 x $3 million). In addition, the cost of the plane, investigation, legal fees, property damage and a single catastrophic event can result in total costs approximating $280 million. This rulemaking is intended to prevent such an outcome from occurring.

III. COSTS

The proposed rule would require that cylinders of compressed oxygen and chemical oxygen generators when shipped on aircraft be packaged in containers that meet certain flame penetration and thermal resistance requirements. Although manufacturers maintain that it is feasible to construct a container that meets the flame penetration requirement, no container with this characteristic has yet been constructed. The key factor in determining the cost impact was measuring the increase in costs over baseline costs.

Baseline Costs

In this analysis, the baseline is defined as current practice. Thus, the baseline takes into account costs that would be incurred in the course of business without the proposed rule under consideration. The RSPA is using the following three assumptions to calculate baseline costs for both oxygen cylinder and oxygen generator overpacks:

- The mandatory date to comply with the requirement was March 1, 2000.
- The required container can be reused for 7-9 years (one-eight are replaced each year).
- After the mandatory date, costs recur when containers may no longer be reused.

Baseline costs are based on an estimate of the average price per container and an estimate of the cost to the industry to comply with the requirement in the mandatory date, March 1, 2000. For oxygen cylinder overpacks the RSPA estimates that the average price per container is $196[2]. RSPA estimates that the cost to the industry to comply with the requirement by the mandatory date is estimated to be $5.9 million (30,000 containers x $196). These numbers are based on expert RSPA opinion and industry views. The total 15-year undiscounted baseline recurring replacement costs are estimated to be $11 million (or $6.7 million discounted). See Appendix A for details.

[2] Source: Viking Packing Specialist, August 2003.

For oxygen generators RSPA estimates that there are 10,000 containers owned and operated by the airlines themselves. It is these containers that have well constructed overpacks and the average cost per container is estimated to be $320. The overpacks used by distributors and factories tend to be disposable. The baseline cost to the industry is estimated to be equal to be $3.2million (10,000 containers x $320). These numbers are based on expert RSPA opinion and industry views. Thus, the total 15-year undiscounted baseline recurring replacement costs are estimated to be $6 million (or $3.6 million discounted). See Appendix B for details.

Proposed Rule

Containers meeting the requirements of this proposal would have to (1) withstand a flame penetration of 1,700°F for 5 minutes; and (2) prevent enclosed cylinders from exceeding a surface temperature of 199°F when the containers are exposed to a mean temperature of 400°F for 3 hours. The RSPA is using the following three assumptions to calculate the cost of the proposed rule over the 15 year period of analysis (these assumptions apply to both oxygen cylinder and oxygen generator overpacks):

- The mandatory year to comply with the requirement would be 2005. (Note: This is not necessarily the year that this rule will become effective. As stated in the preamble of the NPRM, we are proposing an effective date of one year after publication of the final rule.)
- The required container would be reused for 7-9 years.
- After the mandatory year, costs would recur when containers may no longer be reused.

For oxygen cylinders RSPA estimates a $720[3] average cost per container and 30,000 containers needed. The incremental cost of the rule for oxygen overpacks is calculated by first estimating a

[3] Source: Viking Packing Specialist, August 2003.

cost based on these numbers over the 15 years and then subtract out baseline costs (Appendix A). For oxygen cylinders the total 15-year undiscounted cost of this proposed rule is estimated to be $32.2 million (or $21.2 million discounted).

For chemical oxygen generators the costs of the proposed rule are based on an estimate of the average price per container, shipping costs, and an estimate of the cost to the industry to comply with the requirement in the expected mandatory year, 2005 (see note above) minus the cost of complying with the current overpack requirements.

However, in addition to the costs of the oxygen generator overpacks, we also need to include a shipping cost. This is due to the current industry practice of shipping chemical oxygen generators in disposable overpacks from the factory to distribution points and then to its final destination. Under the proposed rule the overpacks instead of simply being disposed of will need to be returned to the factory or distributor.

RSPA has estimated that the industry will need 30,000 containers to transport oxygen generators by cargo aircraft (oxygen generators are forbidden for transports aboard passenger aircraft as cargo). We have estimated that 10,000 of these containers will be used by the airline industry and 20,000 will be used by manufacturers and distributors of oxygen generators. It is RSPA's belief that the containers used by the manufacturers and distributors will be sent to outside companies and therefore, they will incur a "recovery fee" to get the containers back from their customers. We have estimated that the cost of this recovery fee is $22 per return shipment and that each container will need to be shipped back 12 times per year. The total cost of this recovery fee is estimated at $5.28 million per year ($22 x 12 x 20,000). RSPA has not included a shipping cost for the 10,000 airline industry containers because most if not all of the shipments using these containers would be to internal elements of the airline which is current practice.

RSPA estimates that the average price per oxygen generator container would be $844 and that there will be 30,000 containers necessary to be produced. The RSPA estimates that the cost to the industry to comply with the requirement for oxygen generators in the mandatory year would be $30.6 million (30,000 containers x $844) + (20,000 x 12 x $22). After the initial expenditure, there will be subsequent costs as the lifespan of the containers expires as well as the annual transportation cost. The typical lifespan of a container is 8 years. For oxygen generators the total 15-year undiscounted cost of this proposed rule is estimated to be $113.3 million (or $71.1 million discounted) (See Appendix B for details).

Conclusion

The total cost of the rule over 15 years is $145.4 million ($92.3 million discounted). Oxygen cylinders account for $32.2 million ($21.2 million discounted) and oxygen generators account for $113.3 million ($71.1 million discounted). The average annual cost is $9.7 million per year. The RSPA calls for comments on these conclusions and requests that all comments be accompanied by clear documentation.

This proposed rule would prohibit the transportation of all other oxidizing gases aboard cargo and passenger aircraft. These affected materials are covered under the shipping descriptions "Air, refrigerated liquid, (cryogenic liquid)", "Carbon dioxide and oxygen mixtures, compressed", "Nitrous oxide", "Nitrogen triflouride, compressed", "Compressed gas, oxidizing", and "Liquefied gas, oxidizing." However, RSPA has found that these gases are almost never shipped by airplane. The RSPA therefore concludes that there will no measurable costs associated with banning these gases.

IV. INITIAL REGULATORY FLEXIBILITY DETERMINATION

The Regulatory Flexibility Act of 1980 establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation." To achieve that principal, the Act requires agencies to solicit and consider flexible regulatory proposals and to explain the rational for their actions. The Act covers a wide-range of small entities, including small businesses, not-for-profit organizations and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. If the determination is that it will, the agency must prepare a regulatory flexibility analysis (RFA) as described in the Act.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the 1980 act provides that the head of the agency may so certify and an RFA is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

The Small Business Administration recommends that "small" represent the impacted entities with 1,500 or fewer employees. For this proposed rule, small entities are part 121 and part 135 air carriers with 1,500 or fewer employees that were approved to carry hazardous materials. The DOT identified 729 air carriers that meet this definition. The RSPA contacted several of these entities to estimate the number of containers that each small air carrier uses to transport oxygen cylinders aboard aircraft in other than the passenger cabin. From conversations with container manufacturers, the RSPA learned that approximately ten small air carriers transport compressed oxygen cylinders. The RSPA also believes that each of the ten small air carriers would need approximately 5 compressed oxygen containers to comply with the proposed rule. We also estimate that each of ten small carriers would need approximately 5 oxygen generator containers to comply with the proposed rule.

Table 2. Incremental Costs per Small Entity			
Cost per small entity	NPV of Costs over 15 Years	Capital recovery factor	Annualized Costs
Baseline Costs	$2,937	0.10979	$322
Proposed Costs	$10,104	0.10979	$1,109
Incremental Costs	$7,167	0.10979	$787

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations Regulatory Analysis Branch, August 2003.

After calculating the prorated annualized costs per entity using the same assumptions that were used in the cost section, the RSPA has determined that the incremental cost impact per small entity would be $787 (Table 2), which RSPA considers is "de minimus" for a small business (See Appendix C. The baseline costs per small entity shown in Table 2 are generated from Appendix C by adding the baseline discounted costs of oxygen cylinders and chemical oxygen generator overpacks. Similarly, proposed costs in Table 2 are generated by adding discounted costs of the proposed rule for oxygen cylinder and chemical oxygen generator overpacks in Table 2. Annualized costs are calculated by applying a capital recovery factor to total incremental costs.

Besides small airlines, there may also be small entities that are distributors or other types of companies that transport oxygen cylinders and/or chemical oxygen generators on aircraft. RSPA does not belief that any other small entities transport oxygen cylinders. However there may be small entities besides airlines that distribute on airlines chemical oxygen generators and will be affected by this rule. RSPA welcomes cost information from these small entities.

Thus, the RSPA has determined that this proposed rule would not have a significant impact on a substantial number of small entities. RSPA calls for comments on this analysis.

V. INTERNATIONAL TRADE IMPACT ASSESSMENT

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards.

The proposed rule is not expected to affect trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. Furthermore, the proposed rule is consistent with the terms of several trade agreements to which the United States is a signatory, such as the Trade Agreement Act of 1979 (19 U.S.C. 2501 et seq.), incorporating the Agreement on Trade in Civil Aircraft (31 U.S.T. 619) and the Agreement on Technical Barriers to Trade (Standards) (19 U.S.C. 2531). The proposed rule is also consistent with 49 U.S.C. 40105, formerly 1102 (a) of the Federal Aviation Act of 1958, as amended, which requires the RSPA to exercise and perform its powers and duties consistently with any obligation assumed by the United States in any agreement that may be in force between the United States and any foreign country or countries.

VI. UNFUNDED MANDATES ASSESSMENT

Title II of the Unfunded Mandates Reform Act of 1995 (the Act), enacted as Public Law 0104-4 on March 22, 1995, requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate in a proposed or final agency rule that may result in the expenditure of $100 million or more (when adjusted annually for inflation) in any one year by State, local, and tribal governments in the aggregate, or by the private sector. Section 204(a) of the Act, 2 U.S.C. 1534(a), requires the Federal agency to develop an effective process to permit timely input by elected officers (or their designees) of State, local, and tribal governments on a proposed "significant intergovernmental mandate." A "significant intergovernmental mandate" under the Act is any provision in a Federal agency regulation that would impose an enforceable duty upon State, local, and tribal governments in the aggregate of $100 million (adjusted annually for inflation) in any one year. Section 203 of the Act, 2 U.S.C. 1533, which supplements section 204(a), provides that, before establishing any regulatory requirements that might significantly or uniquely affect small governments, the agency shall have developed a plan, which, among other things, must provide for notice to potentially affected small governments, if any, and for a meaningful and timely opportunity for these small governments to provide input in the development of regulatory proposals.

This proposed rule does not contain any Federal intergovernmental or private sector mandates. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply.

APPENDIX A: COSTS OF THE PROPOSED RULE
COMPRESSED OXYGEN CYLINDERS

Baseline:

Table A1. Average Price per Container	
Models	Unit Price
Model 1	$170
Model 2	$175
Model 3	$185
Model 4	$190
Model 5	$190
Model 6	$200
Model 7	$215
Model 8	$215
Model 9	$225
Average price	$196

Source: Viking Packing Specialist. August 2003.

Table A2. Cost to the Industry to Comply with the Requirement in the Mandatory Date, March 1, 2000.	
Number of Containers	30,000
Average Price	$196
Total	$5,883,333

Source for the Number of Containers: Research and Special Programs Administration, DOT. August 2003.

Table A3. Summary of Undiscounted and Discounted Baseline Costs (2003 Dollars).			
Years	Costs	Discount Factor	Discounted Costs
2005	$735,417	0.934579	$687,305
2006	$735,417	0.873439	$642,342
2007	$735,417	0.816298	$600,319
2008	$735,417	0.762895	$561,046
2009	$735,417	0.712986	$524,342
2010	$735,417	0.666342	$490,039
2011	$735,417	0.622750	$457,981
2012	$735,417	0.582009	$428,019
2013	$735,417	0.543934	$400,018
2014	$735,417	0.508349	$373,848
2015	$735,417	0.475093	$349,391
2016	$735,417	0.444012	$326,534
2017	$735,417	0.414964	$305,171
2018	$735,417	0.387817	$285,207
2019	$735,417	0.362446	$266,549
Total	$11,031,250	-	$6,698,111

Source: U.S. Department of Transportation, Federal Aviation Administration,
Operations and Regulatory Analysis Branch. August 2003.

Proposal Rule: construct containers that meet certain flame penetration and resistance requirements.

Table A4. Average Price per Container	
Average unit price	$720

Source: Viking Packing Specialist. August 2003.

Table A5. Cost to the Industry to Comply with the Requirement in the expected Mandatory year, 2005	
Number of Containers	30,000
Average Price	$720
Total	$21,600,000

Source for the Number of Containers: Research and Special Programs Administration, DOT August 2003.

Table A6. Summary of Undiscounted and Discounted Proposed Costs (2003 Dollars)				
	Years	Costs	Discount Factor	Discounted Costs
	2005	-	0.934579	-
	2006	-	0.873439	-
	2007	$21,600,000	0.816298	$17,632,037
	2008	-	0.762895	-
	2009	-	0.712986	-
	2010	-	0.666342	-
	2011	-	0.622750	-
	2012	-	0.582009	-
	2013	-	0.543934	-
	2014	$7,200,000	0.508349	$3,660,113
	2015	$7,200,000	0.475093	$3,420,670
	2016	$7,200,000	0.444012	$3,196,886
	2017		0.414964	
	2018	-	0.387817	-
	2019	-	0.362446	-
	Total	$43,200,000	-	$27,909,706

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Incremental Costs

A7. Discounted Incremental Costs (Proposal - Baseline)		
Years	Incremental Costs	Discounted Incremental Costs
2005-2019	$32,168,750	$21,211,595

APPENDIX B: COSTS OF THE PROPOSED RULE - OXYGEN GENERATORS

Baseline:

Table B1. Average Price per Container	
Average price	$320

Source: Research and Special Programs Adminstration, DOT. August 2003.

Table B2. Baseline Cost to the Industry	
Number of Containers	10,000
Average Price	$320
Total	$3,200,000

Source for the Number of Containers: Research and Special Programs Administration, DOT. August 2003.

Table B3. Summary of Undiscounted and Discounted Baseline Costs (2003 Dollars)

Years	Costs	Discount Factor	Discounted C
2005	$400,000	0.934579	$373,832
2006	$400,000	0.873439	$349,376
2007	$400,000	0.816298	$326,519
2008	$400,000	0.762895	$305,158
2009	$400,000	0.712986	$285,194
2010	$400,000	0.666342	$266,537
2011	$400,000	0.622750	$249,100
2012	$400,000	0.582009	$232,804
2013	$400,000	0.543934	$217,574
2014	$400,000	0.508349	$203,340
2015	$400,000	0.475093	$190,037
2016	$400,000	0.444012	$177,605
2017	$400,000	0.414964	$165,986
2018	$400,000	0.387817	$155,127
2019	$400,000	0.362446	$144,978
Total	$6,000,000	-	$3,643,16

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Proposal Rule: construct containers that meet certain flame penetration and resistance requirements.

Table B4. Average Price per Container	
Average unit price	$844

Source: Viking Packing Specialist. August 2003.

Table B5. Cost to the Industry to Comply with the Requirement in the expected Mandatory year, 2005.	
Number of Containers	30,000
Average Price	$844
Shipping costs (20,000 x 12 x $22)	$5,280,000
Total	$30,600,000

Source for the Number of Containers: Research and Special Programs Administration, DOT. August 2003.

Table B6. Summary of Undiscounted and Discounted Proposed Costs (2003 Dollars).

Years	Costs	Discount Factor	Discounted (
2005	-	0.934579	-
2006	-	0.873439	-
2007	$30,600,000	0.816298	$24,978,7
2008	$5,280,000	0.762895	$4,028,0
2009	$5,280,000	0.712986	$3,764,5
2010	$5,280,000	0.666342	$3,518,2
2011	$5,280,000	0.622750	$3,288,1
2012	$5,280,000	0.582009	$3,073,0
2013	$5,280,000	0.543934	$2,871,9
2014	$13,720,000	0.508349	$6,974,5
2015	$13,720,000	0.475093	$6,518,2
2016	$13,720,000	0.444012	$6,091,8
2017	$5,280,000	0.414964	$5,693,3
2018	$5,280,000	0.387817	$2,047,6
2019	$5,280,000	0.362446	$1,913,7
Total	$119,280,000	-	$74,762,1

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Incremental Costs

B7. Discounted Incremental Costs (Proposal - Baseline)

Years	Incremental Costs	Discounted Incremental Costs
2003-2017	$113,280,000	$71,118,954

APPENDIX C: FLEXIBILITY ANALYSIS

Compressed Oxygen Containers

Baseline:

Table C1. Cost Per Small Entity to Comply with the Requirement in the Mandatory Date, March 1, 2000.	
Number of Containers	5
Average Price	$196
Total	$980

Source for the Number of Containers: Research and Special Programs Administration, DOT. DOT, March 2001

Table C2. Summary of Undiscounted and Discounted Baseline Costs (2003 Dollars).			
Years	Costs	Discount Factor	Discounted Costs
2005	$123	0.934579	$114
2006	$123	0.873439	$107
2007	$123	0.816298	$100
2008	$123	0.762895	$93
2009	$123	0.712986	$87
2010	$123	0.666342	$82
2011	$123	0.622750	$76
2012	$123	0.582009	$71
2013	$123	0.543934	$67
2014	$123	0.508349	$62
2015	$123	0.475093	$58
2016	$123	0.444012	$54
2017	$123	0.414964	$51
2018	$123	0.387817	$48
2019	$123	0.362446	$44
Total	$1,838	-	$1,116

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Proposal Rule: construct compressed oxygen containers that meet certain penetration and resistance requirements.

Table C3. Cost per Small Entity to Comply with the Requirement in the expected Mandatory year, 2005.	
Number of Containers	5
Average Price	$720
Total	$3,600

Source for the Number of Containers: Research and Special Programs Administration, DOT. DOT, January 2001

Table C4. Summary of Undiscounted and Discounted Proposed Costs (2003 Dollars).			
Years	Costs	Discount Factor	Discounted Costs
2005	-	0.934579	-
2006	-	0.873439	-
2007	$3,600	0.816298	$2,939
2008	-	0.762895	-
2009	-	0.712986	-
2010	-	0.666342	-
2011	-	0.622750	-
2012	-	0.582009	-
2013	-	0.543934	-
2014	$1,200	0.508349	$610
2015	$1,200	0.475093	$570
2016	$1,200	0.444012	$533
2017	-	0.414964	-
2018	-	0.387817	-
2019	-	0.362446	-
Total	$7,200	-	$4,652

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Incremental Costs

C5. Discounted Incremental Costs (Proposal - Baseline)		
Years	Incremental Costs	Discounted Incremental Costs
2005-2019	$5,363	$3,536

Oxygen Generators

Baseline:

Table C6. Baseline Cost Per Small Entity	
Number of Containers	5
Average Price	$320
Total	$1,600

Source for the Number of Containers: Research and Special Programs Administration, DOT, August 2003

Table C7. Summary of Undiscounted and Discounted Baseline Costs (2003 Dollars).				
	Years	Costs	Discount Factor	Discounted Costs
	2005	$200	0.934579	$187
	2006	$200	0.873439	$175
	2007	$200	0.816298	$163
	2008	$200	0.762895	$153
	2009	$200	0.712986	$143
	2010	$200	0.666342	$133
	2011	$200	0.622750	$125
	2012	$200	0.582009	$116
	2013	$200	0.543934	$109
	2014	$200	0.508349	$102
	2015	$200	0.475093	$95
	2016	$200	0.444012	$89
	2017	$200	0.414964	$83
	2018	$200	0.387817	$78
	2019	$200	0.362446	$72
	Total	$3,000	-	$1,822

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. September, 2003.

Proposal Rule: construct containers that meet certain flame penetration resistance requirements.

Table C8. Cost to the Industry to Comply with the Requirement in the expected Mandatory year, 2005.	
Number of Containers	5.0
Average Price per container	$844
Shipping Costs	
Total	$4,220

Source for the Number of Containers: Research and Special Programs Administration, August 2003.

Table C9. Summary of Undiscounted and Discounted Proposed Costs (2003 Dollars).			
Years	Costs	Discount Factor	Discounted Costs
2005	-	0.934579	-
2006	-	0.873439	-
2007	$4,220	0.816298	$3,445
2008	$0	0.762895	$0
2009	$0	0.712986	$0
2010	$0	0.666342	$0
2011	$0	0.622750	$0
2012	$0	0.582009	$0
2013	$0	0.543934	$0
2014	$1,407	0.508349	$715
2015	$1,407	0.475093	$668
2016	$1,407	0.444012	$625
2017	$0	0.414964	$0
2018	$0	0.387817	$0
2019	$0	0.362446	$0
Total	$8,440	-	$5,453

Source: U.S. Department of Transportation, Federal Aviation Administration, Operations and Regulatory Analysis Branch. August 2003.

Incremental Costs

C10. Discounted Incremental Costs (Proposal - Baseline)		
Years	Incremental Costs	Discounted Incremental Costs
2005-2019	$5,440	$3,631